ANALYSIS OF ELECTROGENERATED CHEMILUMINESCENCE FROM CONJUGATED POLYMERS

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Electrogenerated Chemiluminescence (ECL) experiments are conducted with Electrode/Monomer or Conjugated Polymer (CP) /Electrolyte assemblies (1). When a positive and a following negative potential steps, corresponding to the oxidation and reduction of the active sites of the CP respectively are applied to the polymer coated electrode, ECL is observed in the second step, due to the recombination of positive and negative polarons. This is called as cathodic ECL, as it is observed during the cathodic potential step. The potential step direction can be reversed, i.e., first negative and then positive potential step to the CP, resulting in anodic ECL. When sequential potential steps are applied, both anodic and cathodic ECL can be obtained. In many cases the intensities of anodic and cathodic ECL are different (2). Besides, the magnitude and width of the potential steps are also known to affect the emission efficiency.

In order to analyse such phenomena, we used an experimental system of Pt/DB-PPV/Acetonitrile with the supporting electrolyte dissolved in it. Potential steps of different magnitudes and widths are applied to the above system in both directions. The ECL transients and the emission spectrum are recorded. As an example, figure1depicts the intense cathodic ECL when we applied the potential steps between +1.5V and -1.5V of duration 1second each.

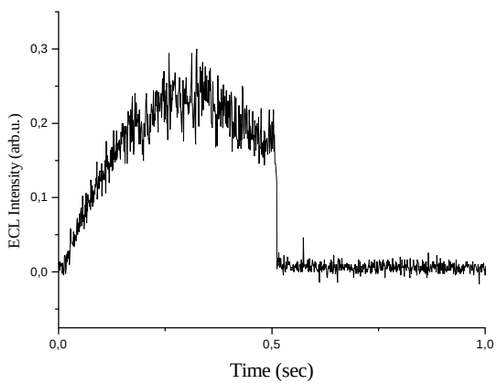

Figure 1. Cathodic ECL obtained when a potential step from +1.5 V to -1.5V of total duration 2 seconds is applied to Pt/DB-PPV/0.1M Tetraethylammonium tetraflouroborate in acetonitrile.

The transients are analysed theoretically for their dependence on the potential step characteristics, based on the model for solution-ECL and are simulated using digital simulation technique (3). The amount and thickness of the polymer are taken into consideration in the calculations.

The experiments are conducted with supporting electrolytes of varying sizes and their effects on the emission efficiency are analysed. It has been found that the current and luminescent transients depend on the type of the supporting electrolyte.

The conditions of improving ECL efficiency, in terms of the characteristics of potential steps and supporting electrolyte are discussed.

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REFERENCES

1. D. Neher, J. Grüner, V. Cimrová, W. Schmidt, R. Rulkens and U. Lauter, Polym. Adv. Technol., 9, 461 (1998) and references therein.
2. H. Nambu, M. Hamaguchi and A. K. Yoshino, J. Appl. Phys., 82, 1847 (1997).
3. J. Rosenmund and K. Doblhofer, J. Electroanal. Chem., 396, 77 (1995).